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(54) **TEMPERATURE-STABILIZED STORAGE SYSTEMS**

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See application file for complete search history.

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(57) **ABSTRACT**

Systems include at least one substantially thermally sealed storage container, including an outer assembly including one or more sections of ultra efficient insulation material substantially defining at least one thermally sealed storage region, and an inner assembly including one or more interlocks configured to provide controllable egress of a quantity of a material from one or more of the at least one thermally sealed storage region.

54 Claims, 7 Drawing Sheets

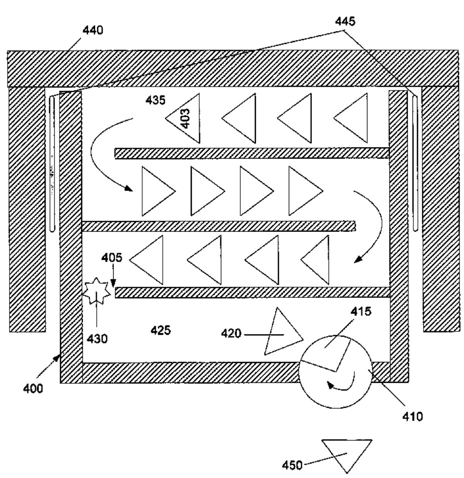

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Fig. 1

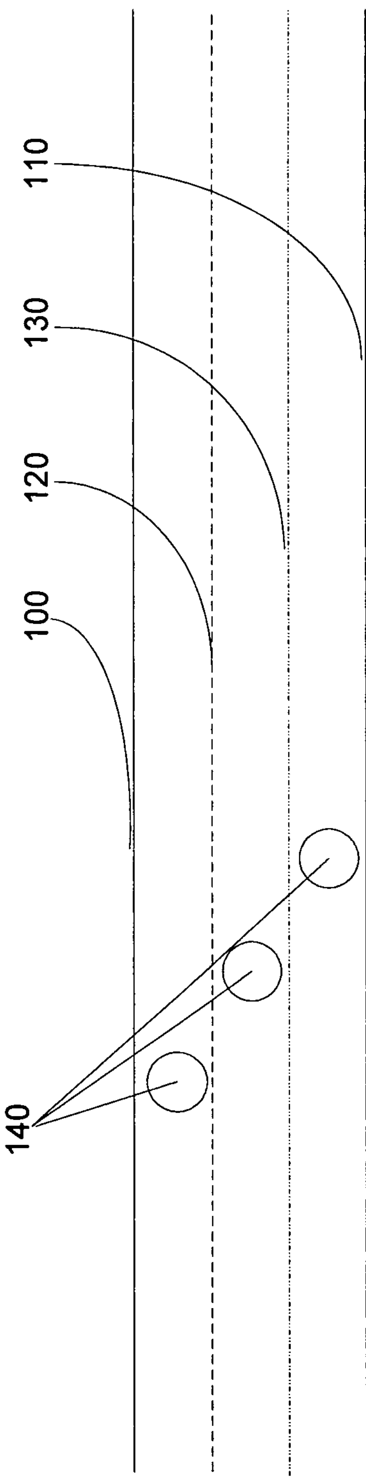
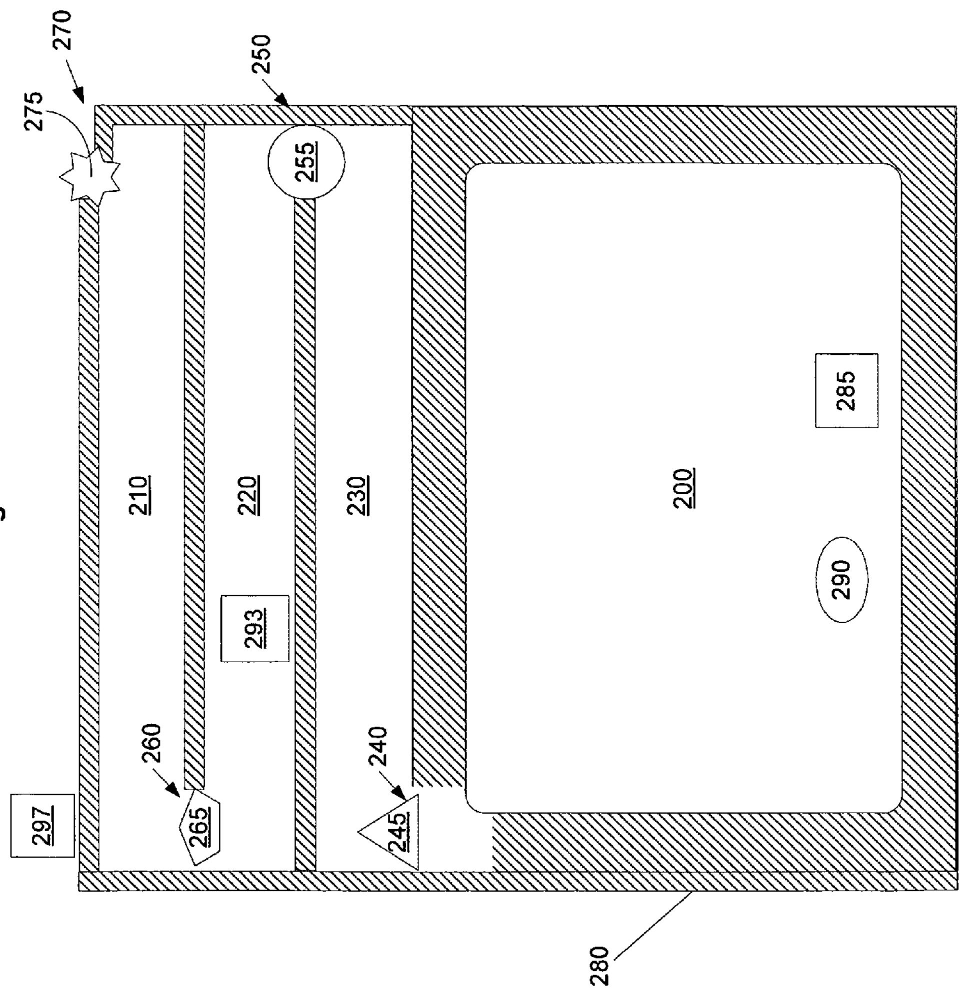


Fig. 2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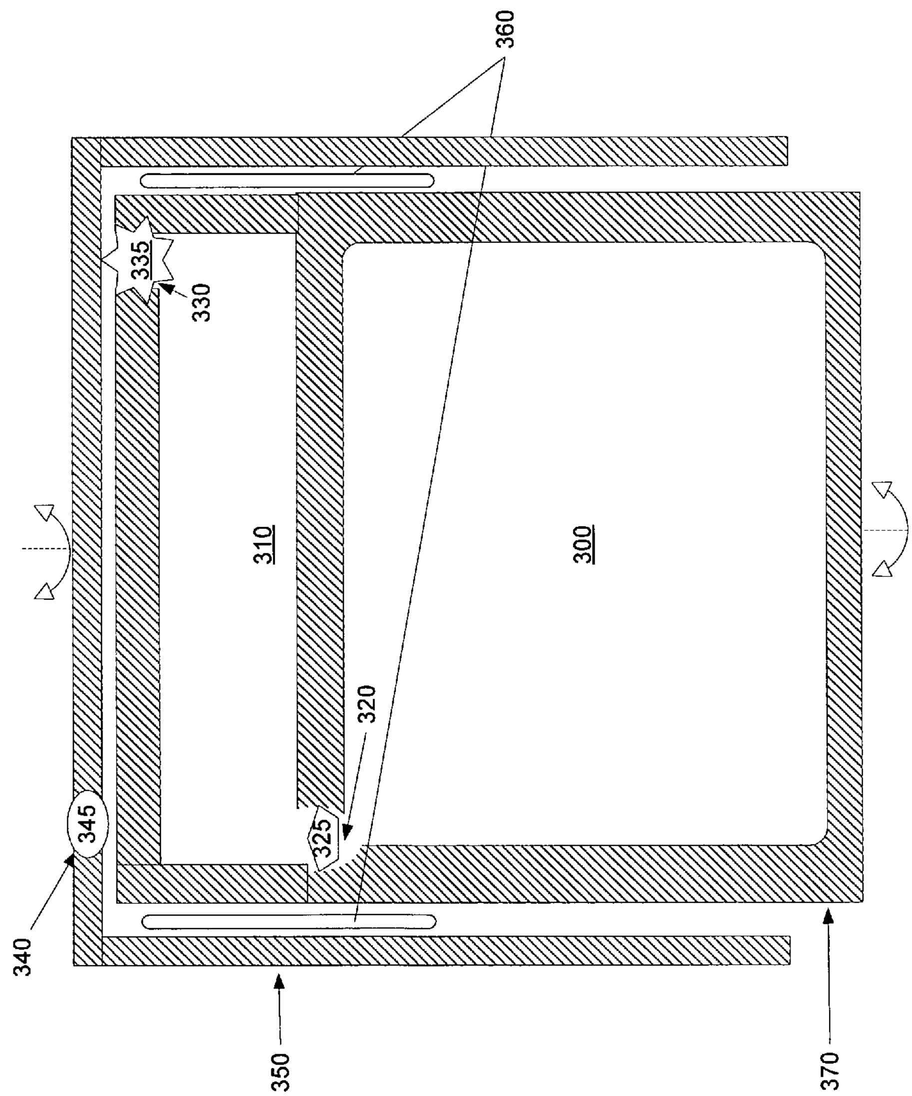


Fig. 3A

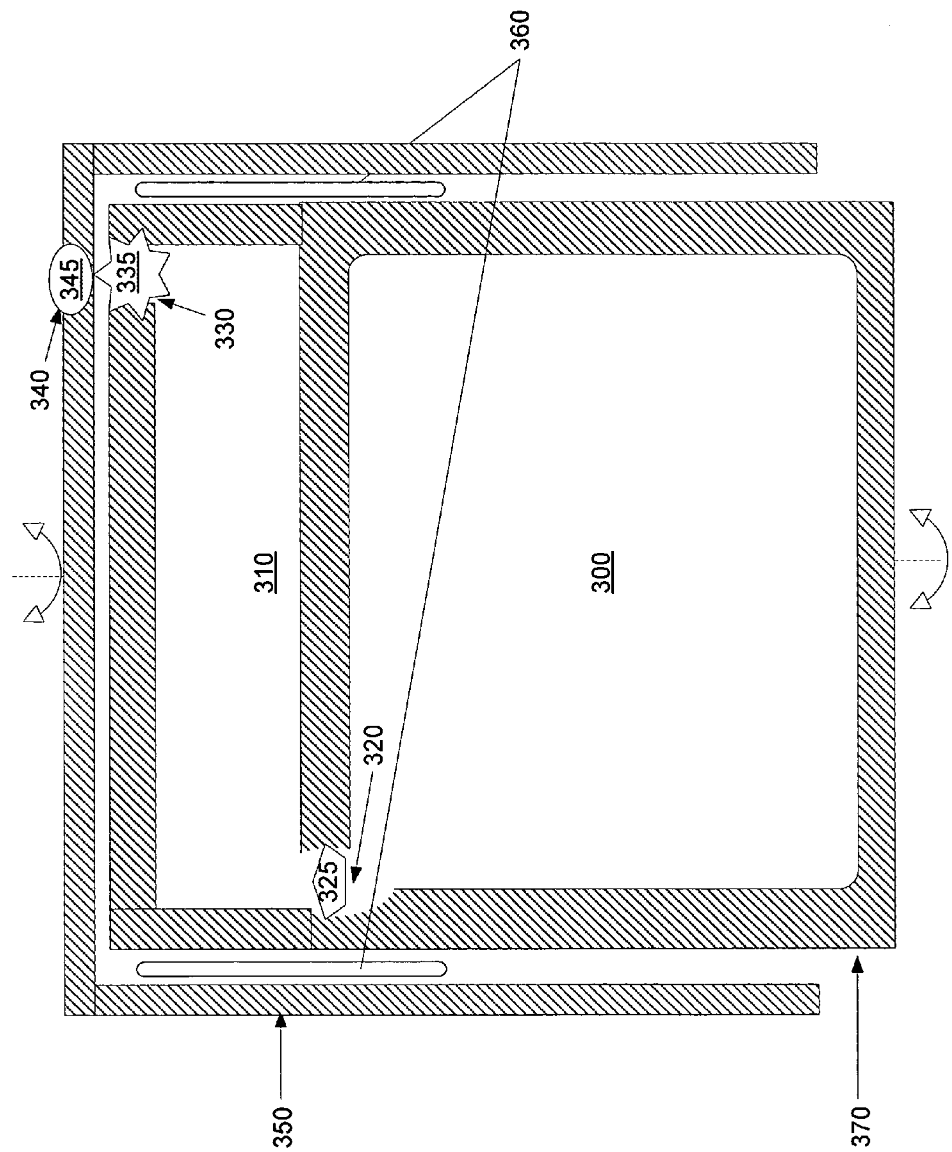
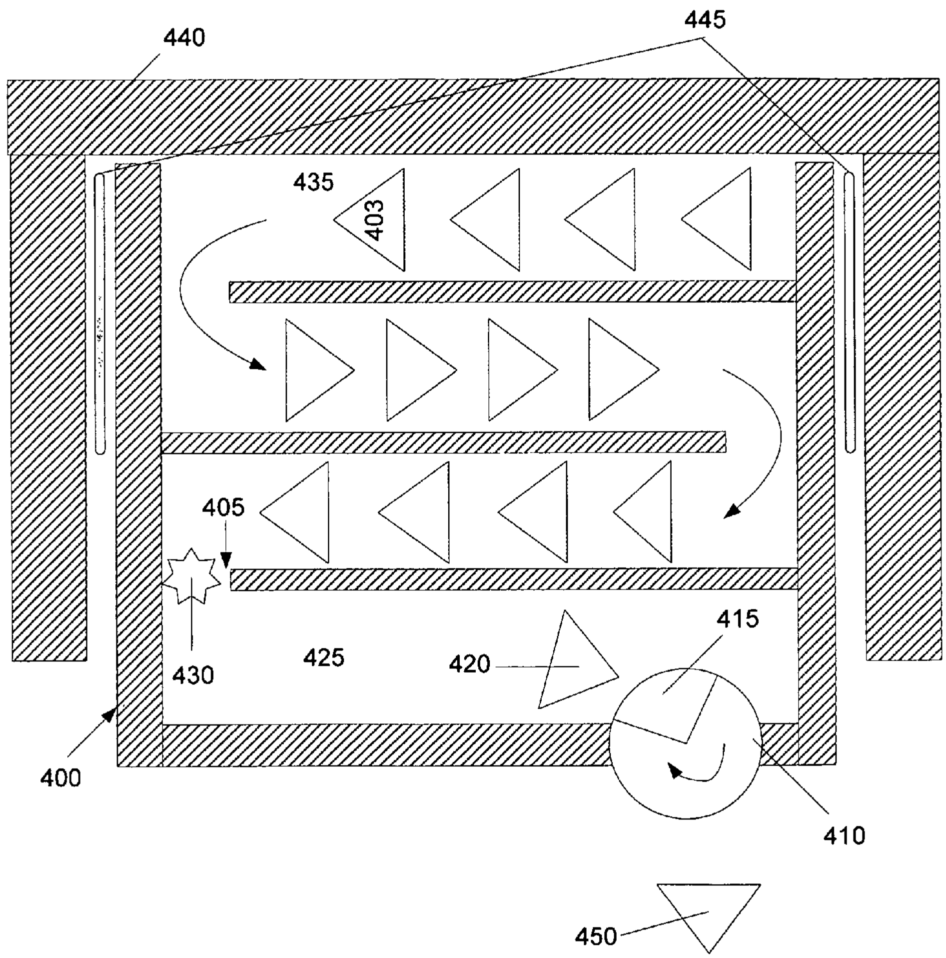


Fig. 3B

Fig. 4



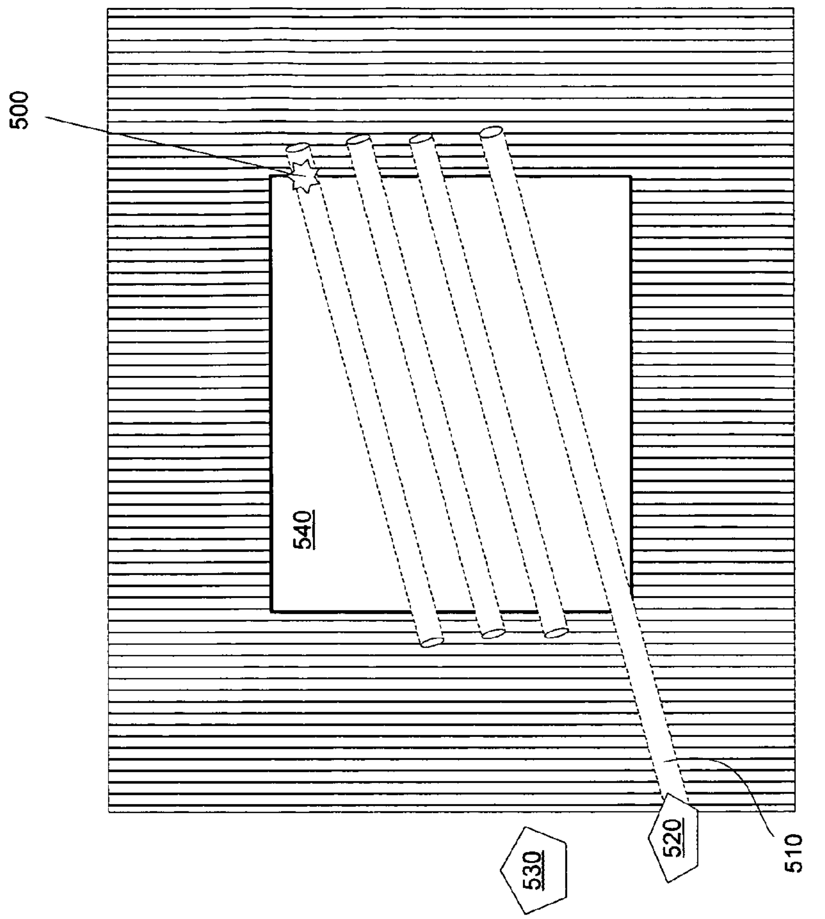


Fig. 5B

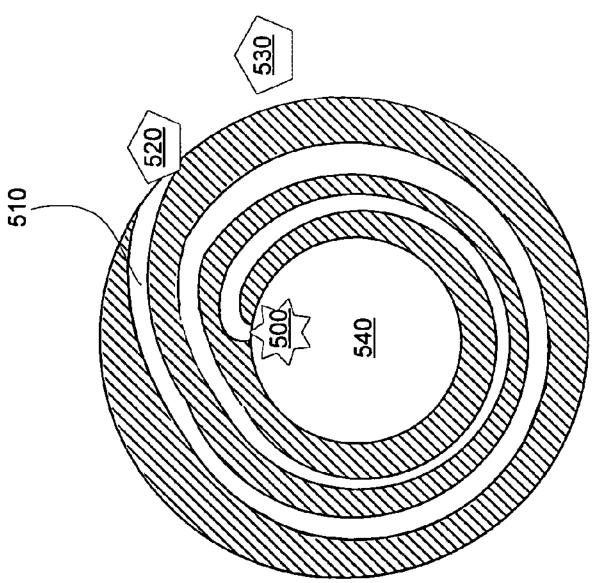
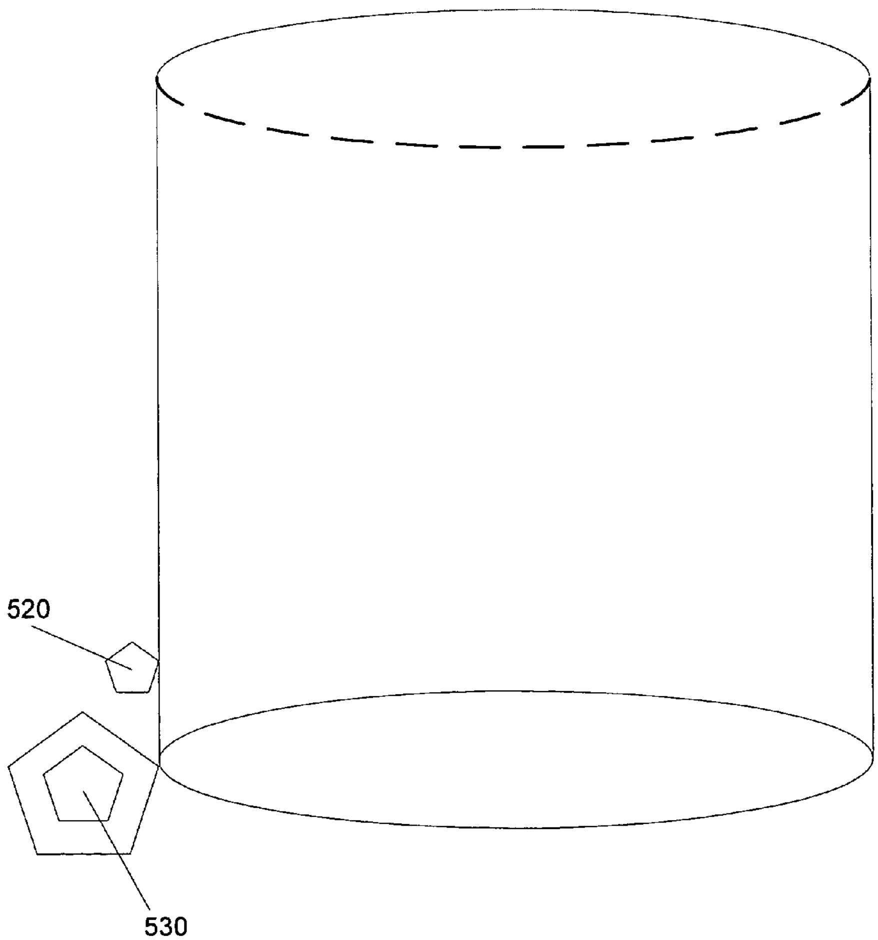


Fig. 5A

Fig. 5C



TEMPERATURE-STABILIZED STORAGE SYSTEMS

CROSS-REFERENCE TO RELATED APPLICATIONS

The present application is related to and claims the benefit of the earliest available effective filing date(s) from the following listed application(s) (the "Related Applications") (e.g., claims earliest available priority dates for other than provisional patent applications or claims benefits under 35 USC §119(e) for provisional patent applications, for any and all parent, grandparent, great-grandparent, etc. applications of the Related Application(s)).

RELATED APPLICATIONS

For purposes of the USPTO extra-statutory requirements, the present application constitutes a continuation-in-part of U.S. patent application Ser. No. 12/001,757, entitled TEMPERATURE-STABILIZED STORAGE CONTAINERS, naming Roderick A. Hyde; Edward K. Y. Jung; Nathan P. Myhrvold; Clarence T. Tegreene; William H. Gates, III; Charles Whitmer; and Lowell L. Wood, Jr. as inventors, filed Dec. 11, 2007, which is currently co-pending, or is an application of which a currently co-pending application is entitled to the benefit of the filing date.

For purposes of the USPTO extra-statutory requirements, the present application constitutes a continuation-in-part of U.S. patent application Ser. No. 12/006,088, entitled TEMPERATURE-STABILIZED STORAGE CONTAINERS WITH DIRECTED ACCESS, naming Roderick A. Hyde; Edward K. Y. Jung; Nathan P. Myhrvold; Clarence T. Tegreene; William H. Gates, III; Charles Whitmer; and Lowell L. Wood, Jr. as inventors, filed Dec. 27, 2007, which is currently co-pending, or is an application of which a currently co-pending application is entitled to the benefit of the filing date.

The United States Patent Office (USPTO) has published a notice to the effect that the USPTO's computer programs require that patent applicants reference both a serial number and indicate whether an application is a continuation or continuation-in-part. Stephen G. Kunin, Benefit of Prior-Filed Application, USPTO Official Gazette Mar. 18, 2003, available at http://www.uspto.gov/web/offices/com/sol/og/2003/week11/patbene.htm. The present Applicant Entity (hereinafter "Applicant") has provided above a specific reference to the application(s) from which priority is being claimed as recited by statute. Applicant understands that the statute is unambiguous in its specific reference language and does not require either a serial number or any characterization, such as "continuation" or "continuation-in-part," for claiming priority to U.S. patent applications. Notwithstanding the foregoing, Applicant understands that the USPTO's computer programs have certain data entry requirements, and hence Applicant is designating the present application as a continuation-in-part of its parent applications as set forth above, but expressly points out that such designations are not to be construed in any way as any type of commentary and/or admission as to whether or not the present application contains any new matter in addition to the matter of its parent application(s).

All subject matter of the Related Applications and of any and all parent, grandparent, great-grandparent, etc. applica-

tions of the Related Applications is incorporated herein by reference to the extent such subject matter is not inconsistent herewith.

SUMMARY

Some aspects include at least one substantially thermally sealed storage container, including an outer assembly including one or more sections of ultra efficient insulation material substantially defining at least one thermally sealed storage region, and an inner assembly including one or more interlocks configured to provide controllable egress of a quantity of a material from one or more of the at least one thermally sealed storage region. In addition to the foregoing, other aspects are described in the claims, drawings, and text forming a part of the present disclosure.

Some aspects include at least one substantially thermally sealed storage container, including an outer assembly including one or more sections of ultra efficient insulation material defining at least one substantially thermally sealed storage region, and an inner assembly including one or more interlocks including at least one first selectively operable passageway between one or more of the at least one storage region and at least one intermediate region, one or more interlocks including at least one second selectively operable passageway between the at least one intermediate region and an exterior of the container, and one or more actuators operably coupled to one or more of the at least one first or second selectively operable passageway configured to open or close said passageway. In addition to the foregoing, other aspects are described in the claims, drawings, and text forming a part of the present disclosure.

Some aspects include at least one substantially thermally sealed storage container, including a structural assembly including one or more sections of ultra efficient insulation material primarily defining at least one substantially thermally sealed storage region, and an outlet assembly including one or more outlet channels, wherein the one or more outlet channels are arranged to provide controllable egress of a quantity of a stored material from the at least one storage region, and the one or more outlet channels substantially follow an extended thermal pathway. In addition to the foregoing, other aspects are described in the claims, drawings, and text forming a part of the present disclosure.

The foregoing summary is illustrative only and is not intended to be in any way limiting. In addition to the illustrative aspects, embodiments, and features described above, further aspects, embodiments, and features will become apparent by reference to the drawings and the following detailed description.

BRIEF DESCRIPTION OF THE FIGURES

FIG. **1** is a schematic of some aspects of an ultra efficient insulation material.

FIG. **2** is a schematic of some aspects of a substantially thermally sealed storage container.

FIG. **3**A is a schematic of some aspects of a substantially thermally sealed storage container.

FIG. **3**B is a schematic of some aspects of the substantially thermally sealed storage container shown in FIG. **3**A.

FIG. **4** is a schematic of some aspects of a substantially thermally sealed storage container.

FIG. **5**A is a schematic of a "top-down" view of a substantially thermally sealed storage container showing some aspects of the container.

FIG. 5B is a schematic of a side-facing "cross-section" view of the substantially thermally sealed storage container shown in FIG. 5A.

FIG. 5C is a schematic of a side-facing exterior view of the substantially thermally sealed storage container shown in FIGS. 5A and 5B.

DETAILED DESCRIPTION

In the following detailed description, reference is made to the accompanying drawings, which form a part hereof. In the drawings, similar symbols typically identify similar components, unless context dictates otherwise. The illustrative embodiments described in the detailed description, drawings, and claims are not meant to be limiting. Other embodiments may be utilized, and other changes may be made, without departing from the spirit or scope of the subject matter presented here.

Some embodiments include at least one substantially thermally sealed storage container, which may include one or more sections of an ultra efficient insulation material. The term "ultra efficient insulation material," as used herein, may include one or more type of insulation material with extremely low heat conductance and extremely low heat radiation transfer between the surfaces of the insulation material. The ultra efficient insulation material may include, for example, one or more layers of thermally reflective film, high vacuum, aerogel, low thermal conductivity bead-like units, disordered layered crystals, low density solids, or low density foam. In some embodiments, the ultra efficient insulation material includes one or more low density solids such as aerogels, such as those described in, for example: Fricke and Emmerling, Aerogels-preparation, properties, applications, Structure and Bonding 77: 37-87 (1992); and Pekala, Organic aerogels from the polycondensation of resorcinol with formaldehyde, Journal of Materials Science 24: 3221-3227 (1989), which are each herein incorporated by reference. As used herein, "low density" may include materials with density from about 0.01 g/cm^3 to about 0.10 g/cm^3, and materials with density from about 0.005 g/cm^3 to about 0.05 g/cm^3. In some embodiments, the ultra efficient insulation material includes one or more layers of disordered layered crystals, such as those described in, for example: Chiritescu et al., Ultralow thermal conductivity in disordered, layered WSe_2 crystals, Science 315: 351-353 (2007), which is herein incorporated by reference. In some embodiments, the ultra efficient insulation material includes at least two layers of thermal reflective film separated, for example, by at least one of: high vacuum, low thermal conductivity spacer units, low thermal conductivity bead like units, or low density foam. In some embodiments, the ultra efficient insulation material may include at least two layers of thermal reflective material and at least one spacer unit between the layers of thermal reflective material. For example, the ultra-efficient insulation material may include at least one multiple layer insulating composite such as described in U.S. Pat. No. 6,485,805 to Smith et al., titled "Multilayer insulation composite," which is herein incorporated by reference. For example, the ultra-efficient insulation material may include at least one metallic sheet insulation system, such as that described in U.S. Pat. No. 5,915,283 to Reed et al., titled "Metallic sheet insulation system," which is herein incorporated by reference. For example, the ultra-efficient insulation material may include at least one thermal insulation system, such as that described in U.S. Pat. No. 6,967,051 to Augustynowicz et al., titled "Thermal insulation systems," which is herein incorporated by reference. For example, the ultra-efficient insulation material may include at least one rigid multilayer material for thermal insulation, such as that described in U.S. Pat. No. 7,001,656 to Maignan et al., titled "Rigid multilayer material for thermal insulation," which is herein incorporated by reference.

In some embodiments, an ultra efficient insulation material includes at least one material described above and at least one superinsulation material. As used herein, a "superinsulation material" may include structures wherein at least two floating thermal radiation shields exist in an evacuated double-wall annulus, closely spaced but thermally separated by at least one poor-conducting fiber-like material.

In some embodiments, one or more sections of the ultra efficient insulation material includes at least two layers of thermal reflective material separated from each other by magnetic suspension. The layers of thermal reflective material may be separated, for example, by magnetic suspension methods including magnetic induction suspension or ferromagnetic suspension. For more information regarding magnetic suspension systems, see Thompson, Eddy current magnetic levitation models and experiments, IEEE Potentials, February/March 2000, 40-44, and Post, Maglev: a new approach, Scientific American, January 2000, 82-87, which are each incorporated herein by reference. Ferromagnetic suspension may include, for example, the use of magnets with a Halbach field distribution. For more information regarding Halbach machine topologies and related applications, see Zhu and Howe, Halbach permanent magnet machines and applications: a review, IEE Proc.-Electr. Power Appl. 148: 299-308 (2001), which is herein incorporated by reference.

In reference now to FIG. 1, in some embodiments, an ultra efficient insulation material may include at least one multilayer insulation material. For example, an ultra efficient insulation material may include multilayer insulation material such as that used in space program launch vehicles, including by NASA. See, e.g., Daryabeigi, Thermal analysis and design optimization of multilayer insulation for reentry aerodynamic heating, Journal of Spacecraft and Rockets 39: 509-514 (2002), which is herein incorporated by reference. Some embodiments may include one or more sections of ultra efficient insulation material comprising at least one layer of thermal reflective material and at least one spacer unit adjacent to the at least one layer of thermal reflective material. As illustrated in FIG. 1, an ultra efficient insulation material may include at least two layers of thermal reflective material **120**, **130** separated by low thermal conductivity spacer units **140**. In some embodiments, one or more sections of ultra efficient insulation material may include at least one layer of thermal reflective material and at least one spacer unit adjacent to the at least one layer of thermal reflective material. The low thermal conductivity spacer units may include, for example, low thermal conductivity bead-like structures, aerogel particles, folds or inserts of thermal reflective film. Although two layers of thermal reflective film are shown in FIG. 1, in some embodiments there may be one layer of thermal reflective film or more than two layers of thermal reflective film. Similarly, there may be greater or fewer numbers of low thermal conductivity spacer units **140** depending on the embodiment. In some embodiments there may be one or more additional layers within or in addition to the ultra efficient insulation material, such as, for example, an outer structural layer **100** or an inner structural layer **110**. An inner or an outer structural layer may be made of any material appropriate to the embodiment, for example an inner or an outer structural layer may include: plastic, metal, alloy, composite, or glass. In some embodiments, there may be one or more layers of high vacuum between layers of thermal reflective film.

Some embodiments may include one or more interlocks. As used herein, an "interlock" includes at least one connection between regions, wherein the interlock acts so that the motion or operation of one part is constrained by another. An interlock may be in an open position, allowing the movement of material from one region to another, or an interlock may be in a closed position to restrict the movement or transfer of material. In some embodiments, an interlock may have intermediate stages or intermediate open positions to regulate or control the movement of material. For example, an interlock may have at least one position that restricts egress of a discrete quantity of a material from at least one storage region. For example, an interlock may act to restrict the egress of a stored unit of a material from a storage region until another previously-stored unit of a material egresses from the container. For example, an interlock may act to allow the egress of only a fixed quantity of stored material or stored units of material from a storage region during a period of time. At least one of the one or more interlocks may operate independently of an electrical power source, or at least one of the one or more interlocks may be electrically operable interlocks. An electrical power source may originate, for example, from municipal electrical power supplies, electric batteries, or an electrical generator device. Interlocks may be mechanically operable interlocks. For example, mechanically operable interlocks may include at least one of: electrically actuated mechanically operable interlocks, electromagnetically operable interlocks, magnetically operable interlocks, mechanically actuated interlocks, ballistically actuated interlocks, dynamically actuated interlocks, centrifugally actuated interlocks, optically actuated interlocks, orientationally actuated interlocks, thermally actuated interlocks, or gravitationally actuated interlocks. In some embodiments, at least one of the one or more interlocks includes at least one magnet.

An interlock may operate to allow the transfer or movement of material from one region to another in a unidirectional or a bidirectional manner. For example, an interlock may operate to allow the transfer of material from a storage region within a container to an intermediate region or a region external to the container in a unidirectional manner, while restricting the transfer or movement of material from a region external to the container into the container. For example, an interlock may operate to allow the transfer of material into at least one storage region within a container, such as for refilling or recharging a supply of material stored within the container. For example, an interlock may operate to restrict the egress of stored material from a storage region while allowing for the ingress of a heat sink material such as dry ice, wet ice, liquid nitrogen, or other heat sink material. For example, an interlock may operate to restrict the egress of stored material from a storage region while allowing the ingress of gas or vapor, such as to equalize the gaseous pressure within at least one region within the container with a gaseous pressure external to the container.

Some embodiments include at least one substantially thermally sealed storage container, including an outer assembly including one or more sections of ultra efficient insulation material substantially defining at least one thermally sealed storage region, and an inner assembly including one or more interlocks configured to provide controllable egress of a discrete quantity of a material from one or more of the at least one thermally sealed storage region.

For example, FIG. **2** illustrates an example of a substantially thermally sealed storage container, including an outer assembly **280** substantially defining a thermally sealed storage region **200**. FIG. **2** depicts interlocks **245**, **255**, **265**, **275** configured to provide controllable egress of a discrete quantity of material from the storage region **200**. Interlocks **245**, **255**, **265**, **275** are configured to provide controllable egress through regions **240**, **250**, **260** and **270** respectively. In some embodiments, there may be two or more intermediate regions one or more of the at least one substantially thermally sealed storage region of the container and the exterior of the container. The interlocks **245**, **255**, **265**, **275** depicted in FIG. **2** are adjacent to intermediate regions **230**, **220**, **210**. FIG. **2** depicts sensors **293**, **297**.

Some embodiments include a substantially thermally sealed storage container, including an outer assembly including one or more sections of ultra efficient insulation material defining at least one substantially thermally sealed storage region; and an inner assembly including one or more interlocks including at least one first selectively operable passageway between one or more of the at least one storage region and at least one intermediate region, one or more interlocks including at least one second selectively operable passageway between the at least one intermediate region and an exterior of the container, and one or more actuators operably coupled to one or more of the at least one first or second selectively operable passageway configured to open or close said passageway. At least one of the actuators may be a mechanical actuator. At least one of the one or more actuators operably coupled to at least one of the one or more first or second selectively operable passageway may include at least one of: electrically actuated mechanically operable actuators, electromagnetically operable actuators, magnetically operable actuators, mechanically actuated actuators, ballistically actuated actuators, dynamically actuated actuators, centrifugally actuated actuators, optically actuated actuators, orientationally actuated actuators, thermally actuated actuators, or gravitationally actuated actuators. For example, a magnetically operable actuator may include a magnetic switching component, so that the actuator opens or closes at least one passageway when the container is in proximity to a magnetic field, such as when a magnet is moved across an outer surface of the container. For example, a gravitationally actuated actuator may include at least one component which is weighted so that the actuator opens or closes at least one passageway when the container is in a particular orientation relative to the earth's gravitational field. For example, a gravitationally actuated actuator may close at least one passageway when the container is in an upright orientation and close the at least one passageway when the container is in a sideways orientation.

FIGS. **3**A and **3**B depicts a substantially thermally sealed storage container including an outer assembly **370** including one or more sections of ultra efficient insulation material substantially defining at least one thermally sealed storage region **300** and an inner assembly including one or more interlocks **325**, **335** configured to provide controllable egress of a discrete quantity of a material from one or more of the at least one thermally sealed storage region **300**. As depicted in FIGS. **3**A and **3**B, a container may include a rotatable region **350** which may rotate through a thermally sealed rotation region **360**. For example a thermally sealed rotation region **360** may include hinges, curves or grooves to allow for movement of rotatable region **350** around an axis of the at least one thermally sealed storage region **300**. Interlock **325** includes a selectively operable passageway **320** between storage region **300** and intermediate region **310**. As depicted in FIG. **3**B, when the rotatable region **350** is in a position to allow for alignment of interlock **335** with mechanical actuator **345**, mechanical actuator **345** may be operably coupled to the selectively operable passageway formed by regions **330**, **340** between intermediate region **310** and the exterior of the container. As depicted in FIG. **3**A, rotatable region **350** also may be in a position to not allow alignment of interlock **335** with mechanical actuator **345**. Rotatable region **350** may therefore include an externally-operable closure operably coupled to one or more of the at least one second selectively operable passageway. As may be readily apparent from FIGS. **3**A and **3**B, material stored in the storage region may include liquids, fluids, semi-fluids, solids, semi-solids, particulates, smaller storage material units (e.g. one or more packaged material units), or smaller storage containers.

FIG. **4** depicts a substantially thermally sealed storage container with an outer assembly including sections of ultra efficient insulation material **400**, **440** substantially defining a substantially thermally sealed storage region **435**, and an inner assembly including one or more interlocks **410** configured to provide controllable egress of a quantity of material (as depicted by triangles e.g. **403**) from the storage region **435**. The container depicted in FIG. **4** includes sections of ultra efficient insulation material **400**, **440** attached via thermally insulating attachment regions **445**. FIG. **4** depicts a passageway **405** between storage region **435** and intermediate region **425**. The movement of stored material **403** though passageway **405** may be controlled by closure **430**. In some embodiments, closure **430** may be externally-operable, for example via remote electronic control, remote magnetic control or shifting the alignment of the container relative to the earth's gravitational field. Material **420** in the intermediate region **425** may have controllable egress from intermediate region **425** via interlock **410**. As depicted in FIG. **4**, material **420** may align with an appropriately sized and shaped region **415** of interlock **410**, and interlock **410** may then rotate to allow for the egress of material (e.g. **450**). Interlock **410** may be externally-operable, for example the rotation of interlock **410** may be via mechanical force, magnetic force, gravitational force, thermal energy, optical force, dynamic force or electromagnetic force, or other externally-operable forces. Although FIG. **4** illustrates multiple discrete units stored in the storage region **435**, in some embodiments there may be a liquid, fluid, multiple material units of different size, multiple material units of different shape, or a single material unit stored in storage region **435**.

In some embodiments, a substantially thermally sealed storage container includes a structural assembly including one or more sections of ultra efficient insulation material primarily defining at least one substantially thermally sealed storage region, and an outlet assembly including one or more outlet channels, wherein the one or more outlet channels are arranged to provide controllable egress of a quantity of a stored material from the at least one storage region, and the one or more outlet channels substantially follow an extended thermal pathway. For example, an extended thermal pathway may have a high aspect ratio. For example, as illustrated in FIG. **5**, views **5**A, **5**B and **5**C, a substantially thermally sealed container includes an outlet channel **510** to provide controllable egress of a quantity of a stored material from the at least one storage region **540**. View **5**A depicts a top-down cross-section view of a container, view **5**B depicts a side-facing cross-section view of the container, and view **5**C depicts an external side-facing view of the container. In some embodiments, a substantially thermally sealed container includes at least one externally-controllable opening between at least one of the one or more outlet channels and one or more of the at least one storage region. For example, FIG. **5** shows a substantially thermally sealed container including an outlet channel **510** and a externally-controllable opening **500** between the outlet channel and one or more of the at least one storage region **540**. In some embodiments, a substantially thermally sealed container includes at least one externally-controllable opening between at least one of the one or more outlet channels and the exterior of the container. For example, FIG. **5** shows a substantially thermally sealed container including an outlet channel **510** and an externally-controllable opening **520** between the outlet channel and the exterior of the container. A container may include a sealable closure **530** for an externally-controllable opening **520**.

As shown in FIGS. **2**, **3**, **4** and **5**, some embodiments include a substantially thermally sealed storage container that includes no active cooling units. The term "active cooling unit," as used herein, includes conductive and radiative cooling mechanisms that require electricity from an external source to operate. For example, active cooling units may include one or more of: actively powered fans, actively pumped refrigerant systems, thermoelectric systems, active heat pump systems, active vapor-compression refrigeration systems and active heat exchanger systems. The external energy required to operate such mechanisms may originate, for example, from municipal electrical power supplies or electric batteries.

In some embodiments the substantially thermally sealed storage container may include one or more heat sink units thermally connected to one or more of the at least one storage region. For example, as illustrated in FIG. **2**, in some embodiments the substantially thermally sealed storage container may include one or more heat sink units **290** thermally connected to one or more of the at least one thermally sealed storage region **200**. In some embodiments, the substantially thermally sealed storage container may include no heat sink units. In some embodiments, the substantially thermally sealed storage container may include no heat sink units within the interior of the container. The term "heat sink unit," as used herein, includes one or more units that absorb thermal energy. See, for example, U.S. Pat. No. 5,390,734 to Voorhes et al., titled "Heat Sink," U.S. Pat. No. 4,057,101 to Ruka et al., titled "Heat Sink," U.S. Pat. No. 4,003,426 to Best et al., titled "Heat or Thermal Energy Storage Structure," and U.S. Pat. No. 4,976,308 to Faghri titled "Thermal Energy Storage Heat Exchanger," which are each incorporated herein by reference. Heat sink units may include, for example: units containing frozen water or other types of ice; units including frozen material that is generally gaseous at ambient temperature and pressure, such as frozen carbon dioxide (CO_2); units including liquid material that is generally gaseous at ambient temperature and pressure, such as liquid nitrogen; units including artificial gels or composites with heat sink properties; units including phase change materials; and units including refrigerants. See, for example: U.S. Pat. No. 5,261,241 to Kitahara et al., titled "Refrigerant," U.S. Pat. No. 4,810,403 to Bivens et al., titled "Halocarbon Blends for Refrigerant Use," U.S. Pat. No. 4,428,854 to Enjo et al., titled "Absorption Refrigerant Compositions for Use in Absorption Refrigeration Systems," and U.S. Pat. No. 4,482,465 to Gray, titled "Hydrocarbon-Halocarbon Refrigerant Blends," which are each herein incorporated by reference.

In some embodiments, a substantially thermally sealed container includes at least one layer of nontoxic material on an interior surface of one or more of the at least one thermally sealed storage region. Nontoxic material may include, for example, material that does not produce residue that may be toxic to the contents of the at least one substantially thermally sealed storage region, or material that does not produce residue that may be toxic to the future users of contents of the at least one substantially thermally sealed storage region. Nontoxic material may include material that maintains the chemical structure of the contents of the at least one substantially thermally sealed storage region, for example nontoxic material may include chemically inert or non-reactive materials. Nontoxic material may include material that has been developed for use in, for example, medical, pharmaceutical or food storage applications. Nontoxic material may include material that may be cleaned or sterilized, for example material that may be irradiated, autoclaved, or disinfected. Nontoxic material may include material that contains one or more antibacterial, antiviral, antimicrobial, or antipathogen agents. For example, nontoxic material may include aldehydes, hypochlorites, oxidizing agents, phenolics, quaternary ammonium compounds, or silver. Nontoxic material may include material that is structurally stable in the presence of one or more cleaning or sterilizing compounds or radiation, such as plastic that retains its structural integrity after irradiation, or metal that does not oxidize in the presence of one or more cleaning or sterilizing compounds. Nontoxic material may include material that consists of multiple layers, with layers removable for cleaning or sterilization, such as for reuse of the at least one substantially thermally sealed storage region. Nontoxic material may include, for example, material including metals, fabrics, papers or plastics.

In some embodiments, a substantially thermally sealed container includes at least one layer including at least one metal on an interior surface of one or more of the at least one thermally sealed storage region. For example, the at least one metal may include gold, aluminum, copper, or silver. The at least one metal may include at least one metal composite or alloy, for example steel, stainless steel, metal matrix composites, gold alloy, aluminum alloy, copper alloy, or silver alloy. In some embodiments, the at least one metal includes metal foil, such as titanium foil, aluminum foil, silver foil, or gold foil. A metal foil may be a component of a composite, such as, for example, in association with polyester film, such as polyethylene terephthalate (PET) polyester film. The at least one layer including at least one metal on the interior surface of at least one storage region may include at least one metal that may be sterilizable or disinfected. For example, the at least one metal may be sterilizable or disinfected using plasmons. For example, the at least one metal may be sterilizable or disinfected using autoclaving, thermal means, or chemical means. Depending on the embodiment, the at least one layer including at least one metal on the interior surface of at least one storage region may include at least one metal that has specific heat transfer properties, such as a thermal radiative properties.

In some embodiments, a substantially thermally sealed storage container includes one or more removable inserts within an interior of one or more of the at least one thermally sealed storage region. The removable inserts may be made of any material appropriate for the embodiment, including nontoxic materials, metal, alloy, composite, or plastic. The one or more removable inserts may include inserts that may be reused or reconditioned. The one or more removable inserts may include inserts that may be cleaned, sterilized, or disinfected as appropriate to the embodiment.

In some embodiments, there may be a substantially thermally sealed storage container including a plurality of storage regions within the container. In some embodiments, the outer assembly including one or more sections of ultra efficient insulation material substantially defines a plurality of thermally sealed storage regions. The plurality of storage regions may be, for example, of comparable size and shape or they may be of differing sizes and shapes as appropriate to the embodiment. Different storage regions may include, for example, various removable inserts, at least one layer including at least one metal on the interior surface of a storage region, or at least one layer of nontoxic material on the interior surface, in any combination or grouping.

Some embodiments may include a substantially thermally sealed storage container including one or more temperature indicators. For example, at least one temperature indicator may be located within one or more of the at least one substantially thermally sealed storage region, at least one temperature indicator may be located exterior to the container, or at least one temperature indicator may be located within the structure of the container. In some embodiments, multiple temperature indicators may be located in multiple positions. Temperature indicators may include temperature indicating labels, which may be reversible or irreversible. See, for example, the Environmental Indicators sold by ShockWatch Company, with headquarters in Dallas Tex., the Temperature Indicators sold by Cole-Palmer Company of Vernon Hills Illinois and the Time Temperature Indicators sold by 3M Company, with corporate headquarters in St. Paul Minn., the brochures for which are each hereby incorporated by reference. Temperature indicators may include time-temperature indicators, such as those described in U.S. Pat. Nos. 5,709,472 and 6,042,264 to Prusik et al., titled "Time-temperature indicator device and method of manufacture" and U.S. Pat. No. 4,057,029 to Seiter, titled "Time-temperature indicator," which are each herein incorporated by reference. Temperature indicators may include, for example, chemically-based indicators, temperature gauges, thermometers, bimetallic strips, or thermocouples.

In some embodiments, a substantially thermally sealed container may include one or more sensors. As illustrated in FIG. **2**, in some embodiments, an integrally thermally sealed container may include one or more sensors **285**, **293**, **297**. At least one sensor **285** may be located within one or more of the at least one substantially thermally sealed storage region, at least one sensor **297** may be located exterior to the container, or at least one sensor **293** may be located within the structure of the container. In some embodiments, multiple sensors may be located in multiple positions. In some embodiments, the one or more sensors includes at least one sensor of a gaseous pressure within one or more of the at least one storage region, sensor of a mass within one or more of the at least one storage region, sensor of a stored volume within one or more of the at least one storage region, sensor of a temperature within one or more of the at least one storage region, or sensor of an identity of an item within one or more of the at least one storage region. In some embodiments, at least one sensor may include a temperature sensor, such as, for example, chemical sensors, thermometers, bimetallic strips, or thermocouples. An integrally thermally sealed container may include one or more sensors such as a physical sensor component such as described in U.S. Pat. No. 6,453,749 to Petrovic et al., titled "Physical sensor component," which is herein incorporated by reference. An integrally thermally sealed container may include one or more sensors such as a pressure sensor such as described in U.S. Pat. No. 5,900,554 to Baba et al., titled "Pressure sensor," which is herein incorporated by reference. An integrally thermally sealed container may include one or more sensors such as a vertically integrated sensor structure such as described in U.S. Pat. No. 5,600,071 to Sooriakumar et al., titled "Vertically integrated sensor structure and method," which is herein incorporated by reference. An integrally thermally sealed container may include one or more sensors such as a system for determining a quantity of liquid or fluid within a container, such as described in U.S. Pat. No. 5,138,559 to Kuehl et al., titled "System and method for measuring liquid mass quantity," U.S. Pat. No. 6,050,598 to Upton, titled "Apparatus for and method of monitoring the mass quantity and density of a fluid in a closed container, and a vehicular air bag system incorporating such apparatus," and U.S. Pat. No. 5,245,869 to Clarke et al., titled "High accuracy mass sensor for monitoring fluid quantity in storage tanks," which are each herein incorporated by reference. An integrally thermally sealed container may include one or more sensors of radio frequency identification ("RFID") tags to identify material within the at least one substantially thermally sealed storage region. RFID tags are well known in the art, for example in U.S. Pat. No. 5,444,223 to Blama, titled "Radio frequency identification tag and method," which is herein incorporated by reference.

In some embodiments, a substantially thermally sealed container may include one or more communications devices. The one or more communications devices, may include, for example, one or more recording devices, one or more transmission devices, one or more display devices, or one or more receivers. Communications devices may include, for example, communication devices that allow a user to detect information about the container visually, auditorily, or via signal to a remote device. Some embodiments may include communications devices on the exterior of the container, including devices attached to the exterior of the container, devices adjacent to the exterior of the container, or devices located at a distance from the exterior of the container. Some embodiments may include communications devices located within the structure of the container. Some embodiments may include communications devices located within at least one of the one or more substantially thermally sealed storage regions. Some embodiments may include at least one display device located at a distance from the container, for example a display located at a distance operably linked to at least one sensor. Some embodiments may include more than one type of communications device, and in some embodiments the devices may be operably linked. For example, some embodiments may contain both a receiver and an operably linked transmission device, so that a signal may be received by the receiver which then causes a transmission to be made from the transmission device. Some embodiments may include more than one type of communications device that are not operably linked. For example, some embodiments may include a transmission device and a display device, wherein the transmission device is not linked to the display device.

In some embodiments, there may be at least one region within an interior of a substantially thermally sealed storage container that is at a higher gaseous pressure than the atmospheric pressure external to the container. In some embodiments, there may be at least one compartment within one or more of the at least one substantially thermally sealed storage region, wherein the at least one compartment is at a higher gaseous pressure than the exterior atmospheric pressure of the container. For example, in reference to FIGS. **2** and **3**, the gaseous pressure in a storage region **200**, **300**, or within intermediate regions **210**, **220**, **230**, or **310** may be at a higher gaseous pressure than the atmospheric pressure external to the container. For example, a region of higher gaseous pressure may include a sealed region with inherently higher gaseous pressure. For example, a region of higher gaseous pressure may include at least one storage region **200**, **300** including positive gaseous pressure relative to the atmospheric pressure external to the container. For example, a region of higher gaseous pressure may include at least one storage region **200**, **300** including one or more sealed storage units with interior positive gaseous pressure relative to the atmospheric pressure external to the container. In some embodiments, there may be at least one region within the interior of the container that is at a lower atmospheric pressure than the atmospheric pressure external to the container. For example, in reference to FIGS. **2** and **3**, the gaseous pressure in a storage region **200**, **300**, or within regions **210**, **220**, **230**, or **310** may be at a lower gaseous pressure than the atmospheric pressure external to the container. For example, a region of lower gaseous pressure may include at least one storage region **200**, **300** including negative gaseous pressure relative to the atmospheric pressure external to the container. For example, a region of lower gaseous pressure may include at least one storage region **200**, **300** including one or more sealed storage units with interior negative gaseous pressure relative to the atmospheric pressure external to the container.

In some embodiments, a substantially thermally sealed storage container includes at least one authentication device, wherein the at least one authentication device may be operably connected to at least one of the one or more interlocks. In some embodiments, a substantially thermally sealed storage container includes at least one authentication device, wherein the at least one authentication device may be operably connected to at least one externally-operable opening, control egress device, communications device, or other component. For example, an authentication device may include a device which may be authenticated with a key, or a device that may be authenticated with a code, such as a password or a combination. For example, an authentication device may include a device that may be authenticated using biometric parameters, such as fingerprints, retinal scans, hand spacing, voice recognition or biofluid composition (e.g. blood, sweat, or saliva).

In some embodiments, a substantially thermally sealed storage container includes at least one logging device, wherein the at least one logging device is operably connected to at least one of the one or more interlocks. In some embodiments, a substantially thermally sealed storage container includes at least one logging device, wherein the at least one logging device may be operably connected to at least one externally-operable opening, control egress device, communications device, or other component. The at least one logging device may be configured to log information desired by the user. In some embodiments, a substantially thermally sealed container may include at least one logging device, wherein the at least one logging device is operably connected to at least one of the one or more outlet channels. For example, a logging device may include a record of authentication via the authentication device, such as a record of times of authentication, operation of authentication or individuals making the authentication. For example, a logging device may record that an authentication device was authenticated with a specific code which identifies a specific individual at one or more specific times. For example, a logging device may record egress of a quantity of a material from one or more of at least one storage region, such as recording that some quantity or units of material egressed at a specific time. For example, a logging device may record information from one or more sensors, one or more temperature indicators, or one or more communications devices.

In some embodiments, a substantially thermally sealed storage container may include at least one control ingress device, wherein the at least one control ingress device is operably connected to at least one of the one or more interlocks. In some embodiments, a substantially thermally sealed storage container includes at least one control ingress device, wherein the at least one control ingress device may be operably connected to at least one externally-operable opening, control egress device, communications device, or other component. For example, at least one control ingress device may control ingress into the inner assembly of the container, such as ingress of: substance or material to be stored, heat sink material, one or more devices, electromagnetic radiation, gas, or vapor.

In some embodiments an integrally thermally sealed container may include one or more recording devices. The one or more recording devices may include devices that are magnetic, electronic, chemical, or transcription based recording devices. One or more recording device may be located within one or more of the at least one substantially thermally sealed storage region, one or more recording device may be located exterior to the container, or one or more recording device may be located within the structure of the container. The one or more recording device may record, for example, the temperature from one or more temperature sensor, the result from one or more temperature indicator, or the gaseous pressure, mass, volume or identity of an item information from at least one sensor within the at least one storage region. In some embodiments, the one or more recording devices may be integrated with one or more sensor. For example, in some embodiments there may be one or more temperature sensors which record the highest, lowest or average temperature detected. For example, in some embodiments, there may be one or more mass sensors which record one or more mass changes within the container over time. For example, in some embodiments, there may be one or more gaseous pressure sensors which record one or more gaseous pressure changes within the container over time.

In some embodiments an integrally thermally sealed container may include one or more transmission device. One or more transmission device may be located within at least one substantially thermally sealed storage region, one or more transmission device may be located exterior to the container, or one or more transmission device may be located within the structure of the container. The one or more transmission device may transmit any signal or information, for example, the temperature from one or more temperature sensor, or the gaseous pressure, mass, volume or identity of an item or information from at least one sensor within the at least one storage region. In some embodiments, the one or more transmission device may be integrated with one or more sensor, or one or more recording device. The one or more transmission devices may transmit by any means known in the art, for example, but not limited to, via radio frequency (e.g. RFID tags), magnetic field, electromagnetic radiation, electromagnetic waves, sonic waves, or radioactivity.

In some embodiments, an integrally thermally sealed container may include one or more receivers. For example, one or more receivers may include devices that detect sonic waves, electromagnetic waves, radio signals, electrical signals, magnetic pulses, or radioactivity. Depending on the embodiment, one or more receiver may be located within one or more of the at least one substantially thermally sealed storage region. In some embodiments, one or more receivers may be located within the structure of the container. In some embodiments, the one or more receivers may be located on the exterior of the container. In some embodiments, the one or more receiver may be operably coupled to another device, such as for example one or more display devices, recording devices or transmission devices. For example, a receiver may be operably coupled to a display device on the exterior of the container so that when an appropriate signal is received, the display device indicates data, such as time or temperature data. For example, a receiver may be operable coupled to a transmission device so that when an appropriate signal is received, the transmission device transmits data, such as location, time, or positional data.

One skilled in the art will recognize that the herein described components (e.g., steps), devices, and objects and the discussion accompanying them are used as examples for the sake of conceptual clarity and that various configuration modifications are within the skill of those in the art. Consequently, as used herein, the specific examples set forth and the accompanying discussion are intended to be representative of their more general classes. In general, use of any specific example herein is also intended to be representative of its class, and the non-inclusion of such specific components (e.g., steps), devices, and objects herein should not be taken as indicating that limitation is desired. Furthermore, the use of particular shapes within a Figure herein is not intended to connote a shape of any particular element. For example, the use of a star-shape for element **275** in FIG. **2** should not be interpreted as meaning that the element **275** in practice should be star-shaped.

All of the above U.S. patents, U.S. patent application publications, U.S. patent applications, foreign patents, foreign patent applications and non-patent publications referred to in this specification or listed in any Application Data Sheet, are incorporated herein by reference, to the extent not inconsistent herewith.

In addition to the foregoing, other system aspects are described in the claims, drawings, and text forming a part of the present disclosure.

With respect to the use of substantially any plural or singular terms herein, those having skill in the art can translate from the plural to the singular or from the singular to the plural as is appropriate to the context or application. The various singular/plural permutations are not expressly set forth herein for sake of clarity.

While particular aspects of the present subject matter described herein have been shown and described, it will be apparent to those skilled in the art that, based upon the teachings herein, changes and modifications may be made without departing from the subject matter described herein and its broader aspects and, therefore, the appended claims are to encompass within their scope all such changes and modifications as are within the true spirit and scope of the subject matter described herein. Furthermore, it is to be understood that the invention is defined by the appended claims. It will be understood by those within the art that, in general, terms used herein, and especially in the appended claims (e.g., bodies of the appended claims) are generally intended as "open" terms (e.g., the term "including" should be interpreted as "including but not limited to," the term "having" should be interpreted as "having at least," the term "includes" should be interpreted as "includes but is not limited to," etc.). It will be further understood by those within the art that if a specific number of an introduced claim recitation is intended, such an intent will be explicitly recited in the claim, and in the absence of such recitation no such intent is present. For example, as an aid to understanding, the following appended claims may contain usage of the introductory phrases "at least one" and "one or more" to introduce claim recitations. However, the use of such phrases should not be construed to imply that the introduction of a claim recitation by the indefinite articles "a" or "an" limits any particular claim containing such introduced claim recitation to inventions containing only one such recitation, even when the same claim includes the introductory phrases "one or more" or "at least one" and indefinite articles such as "a" or "an" (e.g., "a" or "an" should typically be interpreted to mean "at least one" or "one or more"); the same holds true for the use of definite articles used to introduce claim recitations. In addition, even if a specific number of an introduced claim recitation is explicitly recited, those skilled in the art will recognize that such recitation should typically be interpreted to mean at least the recited number (e.g., the bare recitation of "two recitations," without other modifiers, typically means at least two recitations, or two or more recitations). Furthermore, in those instances where a convention analogous to "at least one of A, B, and C, etc." is used, in general such a construction is intended in the sense one having skill in the art would understand the convention (e.g., "a system having at least one of A, B, and C" would include but not be limited to systems that have A alone, B alone, C alone, A and B together, A and C together, B and C together, or A, B, and C together, etc.). In those instances where a convention analogous to "at least one of A, B, or C, etc." is used, in general such a construction is intended in the sense one having skill in the art would understand the convention (e.g., "a system having at least one of A, B, or C" would include but not be limited to systems that have A alone, B alone, C alone, A and B together, A and C together, B and C together, or A, B, and C together, etc.). It will be further understood by those within the art that virtually any disjunctive word or phrase presenting two or more alternative terms, whether in the description, claims, or drawings, should be understood to contemplate the possibilities of including one of the terms, either of the terms, or both terms. For example, the phrase "A or B" will be understood to include the possibilities of "A" or "B" or "A and B."

EXAMPLES

Example 1

A substantially thermally sealed storage container may be used to maintain food items below the freeze point (generally 0° C./32° F.). For example, a substantially thermally sealed storage container may be used to increase the shelf life, for example, of fresh food items. In this instance, a fresh food item might include meat, fish, vegetables, fruits, bread, and/or dairy for which the recommended frozen shelf-life may range from 3 months to 1 year (see, e.g., Cornell University Cooperative Extension, Foodkeeper Guide Fact Sheet, which is herein incorporated by reference). Alternatively, a substantially thermally sealed storage container may be used to maintain the temperature of a frozen dessert item such as, for example, ice cream, frozen yoghurt, or ice cream bar. As such, the substantially thermally sealed storage container may hold one or more single serving units of the food item, for example, a single hamburger patty per unit. Alternatively, the substantially thermally sealed storage container may hold one or more multiple serving units, for example, a dozen hamburger patties per unit. Optionally, the substantially thermally sealed storage container may hold more than one type of frozen food item such as, for example, a meat and a vegetable, either packaged together or as separate units. The substantially thermally sealed storage container may contain an internal thermometer or thermostat that indicates whether or not the contents maintain proper temperature during the course of storage.

Example 2

A substantially thermally sealed storage container may be used to maintain one or more units of liquid or beverage below the freeze point (generally 0° C./32° F.). For example, a substantially thermally sealed storage container may be used to maintain water, for example, in a frozen state. As such, a block or blocks of frozen liquid such as water ice obtained from a substantially thermally sealed storage container may be used, for example, in an emergency setting to keep food or medicines cold in a refrigerator, ice chest, or other insulated container. Optionally, a block or blocks of frozen liquid such as water ice obtained from a substantially thermally sealed storage container may be used in a setting where power for refrigeration is not available or is limited, such as, for example, a field station, a military outpost, a refuge camp, a forest service outpost, a climbing or other expedition base camp, or for recreational outings.

Example 3

A substantially thermally sealed storage container may be used to maintain food items at a specific temperature, such as that maintained by standard refrigeration, generally in the range of 37-40° F. (3-4.5° C.). For example, a substantially thermally sealed storage container may be used to maintain units of fresh, non-pasteurized caviar, for example, for 4 weeks in the range of 37-40° F. (see, e.g., Cornell University Cooperative Extension, Foodkeeper Guide Fact Sheet, which is herein incorporated by reference). Similarly, a substantially thermally sealed storage container may be used to maintain units of hard cheeses in the range of 37-40° F. for 6 or more months, for example.

Example 4

A substantially thermally sealed storage container may be used to maintain a liquid or beverage at a specific temperature. A liquid or beverage might be water or flavored water, dairy product or fruit juice, carbonated soda, wine, beer or distilled spirits, for example. A specific temperature may be that at which the liquid or beverage is best stored, for example, for long term aging. For example, a substantially thermally sealed storage container may be used to store wine at an optimal storage temperature range of 50 to 55° F. (10-12° C.). Similarly, a substantially thermally sealed storage container may be used to store beer at a storage temperature range of 45-65° F. Alternatively, a specific temperature may be that at which a liquid or beverage is preferably served. For example, a substantially thermally sealed storage container may store a beverage in a temperature range of 37-40° F. (3-4.5° C.), comparable to a standard refrigerator. Alternatively, a substantially thermally sealed storage container may store a beverage such as beer, for example, at a temperature appropriate for serving depending upon the type of beer, ranging for example from 37 to 53° F. (3-12° C.). The beverage may be directly packaged into the substantially thermally sealed storage container. Alternatively, the beverage may be packaged separately into a can, carton, or bottle, for example, and than further packaged in the substantially thermally sealed storage container. Controlled egress from the substantially thermally sealed storage container of a defined unit of fluid, either with or without packaging, is managed by the interlocks, as described herein.

Example 5

A substantially thermally sealed storage container may be used to keep fluids intended for intravenous administration at or slightly above body temperature (generally 98.6° F./37° C.). In the medical or surgical setting, for example, a substantially thermally sealed storage container may be used to hold artificial plasma or other blood product at appropriate temperature for immediate use. For example, plasma substitutes such as hydroxyethyl starch (HES) are often administered rapidly to patients with hypovolemia and for hemodilutional autotransfusion (HAT) during surgery and anesthesia (Yamakage et al. Safety and beneficial effect on body core temperature of prewarmed plasma substitute hydroxyethyl starch during anesthesia Anesthesiology (2004) 101:A1285, which is herein incorporated by reference). Addition of these agents at room temperature may result in a drop in the patient's core temperature and as such are best administered at or slightly above body temperature. HES has been shown to be stable at 40° C. for at least 3 months. As such, a blood product such as HES, for example, may be stored at 40° C. in a substantially thermally sealed storage container in individually packaged and sterile 250 to 500 ml units, for example, until needed in a medical or surgical setting.

Example 6

Alternatively, a substantially thermally sealed storage container may be used to maintain units of intravenous (IV) solution at or slightly above body temperature. For example, a substantially thermally sealed storage container may hold one or more IV bags containing dextrose or saline for use, for example, in treating dehydration associated with hypothermia. As the core temperature of a hypothermic individual may already be below normal, addition of intravenous fluids should optimally be performed at body temperature to prevent further cooling (Department of Health & Social Services, State of Alaska, Cold Injuries Guidelines Revised version 2005, which is herein incorporated by reference). As such, a substantially thermally sealed storage container containing 250 to 500 ml units of a prewarmed rehydration solution may be used, for example, by first responders in the field such as a paramedic, an emergency medical technician, search and rescue, coast guard, or military personnel.

Example 7

A substantially thermally sealed storage container may also be used to maintain an object at a specific temperature. For example, an integrally thermally sealed container may be used to keep blankets prewarmed, for example, for use in an emergency or medical setting. A medical setting might include using a prewarmed blanket from a substantially thermally sealed storage container to prevent hypothermia at birth in preterm and/or low birth weight babies (Cohen et al. Thermal efficiency of prewarmed cotton, reflective, and forced-warm-air. Int. J. Trauma. Nurs. (2002) 8:4-8, which is herein incorporated by reference). A prewarmed blanket may be used in an emergency situation to treat an individual exhibiting signs of hypothermia. In the instance where the individual is conscious, the warm blanket may be used to completely wrap the body. In the instance where the individual is unconscious and the peripheral vasculature has become constricted and acidic, the warm blanket or parts of the warm blanket may be used to warm the torso, groin, neck, armpits and/or head and as such prevent further loss of core body temperature (Department of Health & Social Services, State of Alaska, Cold Injuries Guidelines Revised version 2005, which is herein incorporated by reference). It is anticipated that a substantially thermally sealed storage container may be used to hold other items for warming a body or extremities such as for example towels, hat, gloves, socks, pants, shirt, or combination thereof.

Example 8

A substantially thermally sealed storage container under pressure may be used to maintain humidified air or oxygen in the range of 43-45° C. (107-122° F.), for example. In a hypothermic individual, loss of heat during respiration may account for 10% to 30% of the body's heat loss, particularly under conditions in which the ambient air temperature is cold. As such, inhalation of warm, water-saturated air is a non-invasive treatment suitable for active core rewarming in the field and donates heat directly to the head, neck, and thoracic core, warming the hypothalamus, the temperature regulation center, the respiratory center, and the cardiac center at the base of the brainstem. (Department of Health & Social Services, State of Alaska, Cold Injuries Guidelines Revised version 2005, which is herein incorporated by reference). In many cases, this rewarming of the central nervous system at the brainstem reverses the cold-induced depression of the respiratory centers and improves the level of consciousness. Alternatively, a substantially thermally sealed storage container may contain water ranging in temperature, for example, from 99 to 212° F. (37-100° C.) that may be used in conjunction with a face mask to provide prewarmed, humidified air to a hypothermic individual. For example, inhaled ambient air may be passed over steaming, prewarmed water prior to entering an individual's lungs. As such, a substantially thermally sealed storage container may dispense a unit of prewarmed water to an external vessel attached to the breathing apparatus. Alternatively, a substantially thermally sealed storage container may dispense a packaged unit of prewarmed water that may be designed to attach directly to the breathing apparatus, for example.

Example 9

A substantially thermally sealed storage container may be used to maintain water, for example, at a temperature appropriate for bathing or cleaning dishes, clothes, and/or equipment in the field. For example, a substantially thermally sealed storage container may contain water at a temperature range of 80 to 100° F. for a "field shower" for use by military, forest service, or first responders, for example, in an emergency following exposure to a hazardous chemical or agent. As such, egress of defined units such as, for example, gallons of warm water may be controlled by interlocks, as described herein.

Example 10

A substantially thermally sealed storage container may be used to maintain water at or just below boiling temperature of 212° F./100° C. In some settings, the water may be sterilized. Boiling water may be used for heating and cooking a variety of ready to eat items such as, for example, beverages including coffee, tea, hot chocolate, and cider, and foods including dehydrated foods and instant soup, noodles, and oatmeal. As such, the substantially thermally sealed storage container may dispense discrete units of water such as, for example, 8 ounces per unit at or near boiling in an emergency or remote setting, for example, where the capacity to heat water by other means is unavailable or limited.

Example 11

A substantially thermally sealed storage container may be used to maintain a non-edible liquid at a specific temperature to facilitate immediate use. For example, a substantially thermally sealed storage container may contain ready to use hot mix asphalt maintained within an optimal spreading temperature range of 280 to 300° F. Hot mix asphalt is routinely used for large paving projects and is manufactured at a local hot mix asphalt facility and delivered to the paving site already warm and ready to be used. As such, hot mix asphalt maintained at temperature in a substantially thermally sealed storage container may be used in those situations in which a local hot mix asphalt facility is not available, for example after damage to a road or an airfield in a remote location, disaster area and/or war zone. Alternatively, hot mix asphalt maintained at temperature in a substantially thermally sealed storage container may be used for a patching project or projects requiring immediate attention by a road or airstrip crew. Optionally, a substantially thermally sealed storage container may be used to maintain new formulations of asphalt such as, for example, warm mix asphalt at temperature ranges of 160-180° F. (Suttmeier, Warm mix asphalt: a cooler alternative (2006) Material Matters, Spring: 21-22, which is herein incorporated by reference).

Example 12

A substantially thermally sealed storage container may be used to maintain a solution of deicing material, such as, for example, ethylene glycol, propylene glycol, salt solutions, urea solutions, or a combination thereof at a temperature appropriate to facilitate removal of ice, snow and/or frost. Propylene glycol is capable of lowering the freezing point of water to about −60° C. and is a common component of solutions used to deice airplanes, for example. Propylene glycol in combination with water and additional salts and/or urea is usually sprayed on hot, in a temperature range of 150 to 180° F., and at high pressure. A small amount of deicing material, for example 25-50 gallons, may be used on an otherwise dry, cold day to warm fuel tanks. Alternatively, a much as 1700 gallons of deicing material have been reportedly used per plane during heavy snow fall. As such, a substantially thermally sealed storage container may dispense a unit of 25-50 gallons, for example, of prewarmed deicing material for minimal deicing of a plane. Alternatively, a substantially thermally sealed storage container may be configured to dispense a large volume or multiple small volume units of deicing material, as appropriate for the conditions.

While various aspects and embodiments have been disclosed herein, other aspects and embodiments will be apparent to those skilled in the art. The various aspects and embodiments disclosed herein are for purposes of illustration and are not intended to be limiting, with the true scope and spirit being indicated by the following claims.

What is claimed is:

1. A substantially thermally sealed storage container, comprising:

an outer assembly including one or more sections of ultra efficient insulation material substantially defining at least one thermally sealed storage region, wherein the ultra efficient insulation material includes at least two layers of thermal reflective film separated by vacuum, and wherein the outer assembly includes a mechanically operable outer assembly interlock configured to reversibly restrict egress of one or more packaged material units when closed or allow egress of the one or more packaged material units when open;

an inner assembly including a mechanically operable inner assembly interlock including a region of a size and shape to align with the one or more packaged material units and configured to reversibly restrict egress of the one or more packaged material units when closed or allow egress of the one or more packaged material units when open to provide controllable egress of the one or more packaged material units from one or more of the at least one thermally sealed storage region to the mechanically operable outer assembly interlock;

an intermediate region between the inner assembly interlock and the outer assembly interlock, the intermediate region following a serpentine path through which the one or more packaged material units are removable from the at least one thermally sealed storage region, the intermediate region configured to completely enclose the one or more packaged materials therein between the closed inner and outer interlock assemblies; and

one or more heat sink units containing frozen water, the one or more heat sink units thermally connected to one or more of the at least one thermally sealed storage region.

2. The substantially thermally sealed storage container of claim **1**, wherein at least one of the inner assembly interlock or the outer assembly interlock operate independently of an electrical power source.

3. The substantially thermally sealed storage container of claim **1**, wherein the container includes no active cooling units.

4. The substantially thermally sealed storage container of claim **1**, wherein the one or more sections of ultra efficient insulation material include at least one superinsulation material.

5. The substantially thermally sealed storage container of claim **1**, wherein the one or more sections of ultra efficient insulation material include:

at least one layer of thermal reflective material; and

at least one spacer unit adjacent to the at least one layer of thermal reflective material.

6. The substantially thermally sealed storage container of claim **1**, comprising:

at least one layer of nontoxic material on an interior surface of one or more of the at least one thermally sealed storage region.

7. The substantially thermally sealed storage container of claim **1**, comprising:

at least one layer including at least one metal on an interior surface of one or more of the at least one thermally sealed storage region.

8. The substantially thermally sealed storage container of claim **1**, wherein the outer assembly including one or more sections of ultra efficient insulation material substantially defines a plurality of thermally sealed storage regions.

9. The substantially thermally sealed storage container of claim **1**, comprising:

one or more temperature indicators.

10. The substantially thermally sealed storage container of claim **1**, comprising:

one or more sensors.

11. The substantially thermally sealed storage container of claim **1**, comprising:

one or more communications devices.

12. The substantially thermally sealed storage container of claim **11**, wherein the one or more communications devices includes at least one:

one or more recording devices, one or more transmission devices, one or more display devices, or one or more receivers.

13. The substantially thermally sealed storage container of claim **1**, comprising:

at least one region within an interior of the container that is at a higher gaseous pressure than the atmospheric pressure exterior to the container.

14. The substantially thermally sealed storage container of claim 1, comprising:

at least one authentication device, wherein the at least one authentication device is operably connected to at least one of the inner assembly interlock or the outer assembly interlock.

15. The substantially thermally sealed storage container of claim 1, comprising:

at least one logging device, wherein the at least one logging device is operably connected to at least one of the inner assembly interlock or the outer assembly interlock.

16. The substantially thermally sealed storage container of claim 1, comprising:

at least one control ingress device, wherein the at least one control ingress device is operably connected to at least one of the inner assembly interlock or the outer assembly interlock.

17. A substantially thermally sealed storage container, comprising:

an outer assembly including one or more sections of ultra efficient insulation material defining at least one substantially thermally sealed storage region, wherein the ultra efficient insulation material includes at least two layers of thermal reflective film separated by vacuum;

an inner assembly including:

an intermediate region configured to completely enclose the one or more packaged material units therein;

one or more first mechanically operable interlocks including at least one first selectively operable passageway including a region of a size and shape to align with the one or more packaged material units to provide controllable egress of the one or more packaged material units from the at least one thermally sealed storage region, the first selectively operable passageway between one or more of the at least one storage region and the intermediate region, the one or more first mechanically operable interlocks configured to reversibly restrict egress of the one or more packaged material units when closed or allow egress of the one or more packaged material units when open;

one or more second mechanically operable interlocks including at least one second selectively operable passageway between the intermediate region and an exterior of the container, the one or more second mechanically operable interlocks configured to reversibly restrict egress of the one or more packaged material units when closed or allow egress of the one or more packaged material units when open, wherein the intermediate region extends between the one or more first mechanically operable interlocks and the one or more second mechanically operable interlocks; and

one or more mechanical actuators operably coupled to one or more of the at least one first or second selectively operable passageway configured to open or close said first or second selectively operable passageway; and

one or more heat sink units containing frozen water, the one or more heat sink units thermally connected to one or more of the at least one thermally sealed storage region.

18. The substantially thermally sealed storage container of claim 17, wherein at least one of the one or more mechanically operable interlocks operate independently of an electrical power source.

19. The substantially thermally sealed storage container of claim 17, wherein the one or more mechanically operable interlocks including at least one first selectively operable passageway include at least one magnet and the one or more mechanically operable interlocks including at least one second selectively operable passageway include at least one magnet.

20. The substantially thermally sealed storage container of claim 17, wherein the container includes no active cooling units.

21. The substantially thermally sealed storage container of claim 17, wherein there are two or more intermediate regions between one or more of the at least one substantially thermally sealed storage region of the container and the exterior of the container.

22. The substantially thermally sealed storage container of claim 17, comprising:

at least one externally-operable closure operably coupled to one or more of the at least one second selectively operable passageway.

23. The substantially thermally sealed storage container of claim 17, wherein the one or more sections of ultra efficient insulation material include:

at least one layer of thermal reflective material; and

at least one spacer unit adjacent to the at least one layer of thermal reflective material.

24. The substantially thermally sealed storage container of claim 17, wherein the one or more sections of ultra efficient insulation material include at least one superinsulation material.

25. The substantially thermally sealed storage container of claim 17, comprising:

at least one layer of nontoxic material on an interior surface of one or more of the at least one substantially thermally sealed storage region.

26. The substantially thermally sealed storage container of claim 17, comprising:

at least one layer including at least one metal on an interior surface of one or more of the at least one substantially thermally sealed storage region.

27. The substantially thermally sealed storage container of claim 17, wherein there are a plurality of storage regions within the container.

28. The substantially thermally sealed storage container of claim 17, comprising:

one or more temperature indicators.

29. The substantially thermally sealed storage container of claim 17, comprising:

one or more sensors.

30. The substantially thermally sealed storage container of claim 17, comprising:

one or more communications devices.

31. The substantially thermally sealed storage container of claim 17, comprising:

at least one compartment within one or more of the at least one substantially thermally sealed storage region, wherein the at least one compartment is at a higher gaseous pressure than the exterior atmospheric pressure of the container.

32. The substantially thermally sealed storage container of claim 17, comprising:

at least one authentication device, wherein the at least one authentication device is operably connected to at least one of the one or more mechanically operable interlocks.

33. The substantially thermally sealed storage container of claim 17, comprising:

at least one logging device, wherein the at least one logging device is operably connected to at least one of the one or more mechanically operable interlocks.

34. The substantially thermally sealed storage container of claim **17**, comprising:

at least one control ingress device, wherein the at least one control ingress device is operably connected to at least one of the one or more mechanically operable interlocks.

35. A substantially thermally sealed storage container, comprising:

a structural assembly including one or more sections of ultra efficient insulation material primarily defining at least one substantially thermally sealed storage region including an interior surface and an exterior surface, wherein the ultra efficient insulation material includes at least two layers of thermal reflective material separated by vacuum;

an outlet assembly including one or more elongated outlet channels that follow a serpentine path traversing laterally from a first side of the interior surface of the thermally sealed storage region to a second side of the interior surface of the thermally sealed storage container substantially opposite to the first side, wherein the one or more elongated outlet channels include a region of a size and shape to align with one or more packaged material units to provide controllable egress of the one or more packaged material units from the at least one storage region, and wherein the one or more elongated outlet channels substantially follow an elongated thermal pathway with a high aspect ratio; and

one or more heat sink units containing frozen water, the one or more heat sink units thermally connected to one or more of the at least one thermally sealed storage region.

36. The substantially thermally sealed storage container of claim **35**, comprising:

at least one externally-controllable opening between at least one of the one or more elongated outlet channels and one or more of the at least one substantially thermally sealed storage region.

37. The substantially thermally sealed storage container of claim **35**, comprising:

at least one externally-controllable opening between at least one of the one or more elongated outlet channels and the exterior of the container.

38. The substantially thermally sealed storage container of claim **35**, wherein the container includes no active cooling units.

39. The substantially thermally sealed storage container of claim **35**, wherein the one or more sections of ultra efficient insulation material include:

at least one layer of thermal reflective material; and

at least one spacer unit adjacent to the at least one layer of thermal reflective material.

40. The substantially thermally sealed storage container of claim **35**, wherein the one or more sections of ultra efficient insulation material include at least one superinsulation material.

41. The substantially thermally sealed storage container of claim **35**, comprising:

at least one layer of nontoxic material on an interior surface of one or more of the at least one substantially thermally sealed storage region.

42. The substantially thermally sealed storage container of claim **35**, comprising:

at least one layer including at least one metal on an interior surface of one or more of the at least one substantially thermally sealed storage region.

43. The substantially thermally sealed storage container of claim **35**, comprising:

one or more temperature indicators.

44. The substantially thermally sealed storage container of claim **35**, comprising:

one or more sensors.

45. The substantially thermally sealed storage container of claim **35**, comprising:

one or more communications devices.

46. The substantially thermally sealed storage container of claim **35**, comprising:

at least one compartment within one or more of the at least one substantially thermally sealed storage region that is at a higher gaseous pressure than the atmospheric pressure outside of the container.

47. The substantially thermally sealed storage container of claim **35**, comprising:

at least one authentication device, wherein the at least one authentication device is operably connected to at least one of the one or more elongated outlet channels.

48. The substantially thermally sealed storage container of claim **35**, comprising:

at least one logging device, wherein the at least one logging device is operably connected to at least one of the one or more elongated outlet channels.

49. The substantially thermally sealed storage container of claim **35**, comprising:

at least one externally-controllable opening between at least one of the one or more elongated outlet channels and one or more of the at least one substantially thermally sealed storage region or at least one externally-controllable opening between at least one of the one or more elongated outlet channels and the exterior of the container

at least one control ingress device, wherein the at least one control ingress device is operably connected to at least one of the externally-controllable openings.

50. The substantially thermally sealed storage container of claim **1**, comprising:

one or more removable inserts within an interior of one or more of the at least one thermally sealed storage region.

51. The substantially thermally sealed storage container of claim **17**, comprising:

one or more removable inserts within an interior of one or more of the at least one substantially thermally sealed storage region.

52. The substantially thermally sealed storage container of claim **35**, comprising:

one or more removable inserts within an interior of one or more of the at least one substantially thermally sealed storage region.

53. A substantially thermally sealed storage container, comprising:

an outer assembly including one or more sections of ultra efficient insulation material, the ultra efficient insulation material including high vacuum;

an outer structural layer substantially covering an exterior surface of the outer assembly;

an inner structural layer substantially covering an interior surface of the outer assembly, the inner structural layer defining a substantially thermally sealed storage region;

an inner assembly positioned within the substantially thermally sealed storage region, the inner assembly including one or more mechanically operable interlocks configured to reversibly restrict egress of one or more packaged material units when closed or allow egress of the one or more packaged material units when open, the one or more mechanically operable interlocks including a region of a size and shape to align with one or more packaged material units to provide controllable egress of a quantity of the one or more packaged material units from the substantially thermally sealed storage region;

one or more intermediate regions between the one or more mechanically operable interlocks, the one or more intermediate regions following a serpentine path through which the one or more packaged material units are removable from the substantially sealed thermally sealed storage region, the one or more intermediate regions sized and configured to completely enclose one or more of the one or more packaged material units therein between the closed one or more mechanically operable interlocks; and

one or more heat sink units containing frozen water, the one or more heat sink units thermally connected to one or more of the at least one thermally sealed storage region.

54. The substantially thermally sealed storage container of claim **35**, wherein the one or more elongated outlet channels and the elongated thermal pathway with a high aspect ratio exhibit a spiral configuration.

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